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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S.FE)/S1 (PT)(S) June 2024 (2019 Scheme)/S3 (WP)(R) December 2023 Examination

Course Code: CET201

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

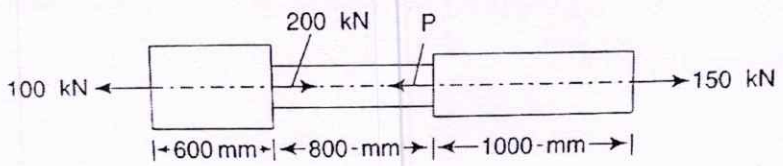
1	What is stress? In what way does the shear stress differ from direct stress?	(3)
2	Define factor of safety? What is its importance?	(3)
3	What do you mean by temperature stresses? Explain.	(3)
4	Define bulk modulus. Deduce the relation $E = 3K(1-2\mu)$	(3)
5	What are the main types of supports? Distinguish between roller and hinged supports	(3)
6	Define the terms 'shear force' and 'bending moment'	(3)
7	Write the equation of simple bending and state each term involved in it.	(3)
8	Deduce a relation for the shear stress across a rectangular cross-section. What is the maximum value of shear stress?	(3)
9	What do you mean by principal planes and principal stresses?	(3)
10	Define slenderness ratio of a column. What is its importance?	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

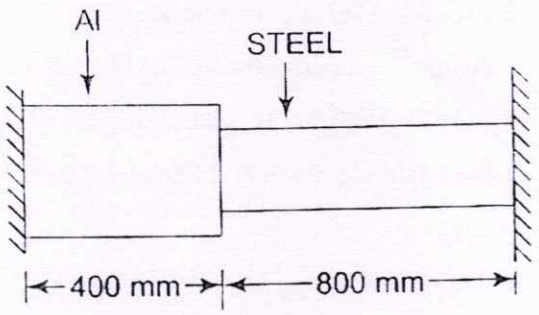
11	Determine the force P necessary for the equilibrium of a steel bar shown in figure. The diameters of the first, middle and last segments of the bar are 30 mm, 25 mm and 30 mm respectively. Also, find the elongation of the bar. E = 200 Gpa.	(14)



12 An assembly of a steel bar of 60 mm diameter enclosed in an aluminium tube of 70 mm internal diameter and 110 mm external diameter is compressed between two rigid parallel plates by a force of 300 kN. The length of the assembly is 1 m. Determine the stresses in the tube and the bar if E_s = 200 Gpa and E_{al} = 70 Gpa. (14)

Module 2

13a A composite bar made up of aluminium and steel is rigidly attached to end supports at 60°C as shown in figure. Find the stresses in the two portions of the bar when the temperature of the composite system falls to 20°C, if the ends do not yield. E_s = 200 GPa. E_{al} = 70 GPa. α_s = 11.7 x 10^{-6}/°c. α_{al} = 23.4 x 10^{-6}/°C. cross sectional area of steel section = 250 mm^2 and aluminium section = 375 mm^2 (8)



13b A load of 120 kN is applied to a bar of 20 mm diameter. The bar which is 400 mm long is elongated by 0.7 mm. Determine the modulus of elasticity of the bar material. If the Poisson's ratio is 0.3, find the change in diameter. (6)

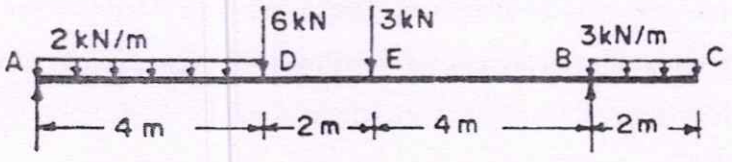
14a A steel rod of 20 mm diameter passes centrally through a copper tube 40 mm external diameter and 30 mm internal diameter. The tube is enclosed at each end by a rigid plates of negligible thickness. If the temperature of the assembly is raised by 60°c, calculate the stresses developed in copper and steel. Take E_s = 200 GPa. E_{cu} = 100 GPa. α_s = 12 x 10^{-6}/°c. α_{cu} = 18 x 10^{-6}/°C. (8)

14b A thin cylinder of internal diameter 1.25 m contains a fluid at an internal pressure of 2 N/mm^2. Determine the maximum thickness of the cylinder if, (i) the longitudinal stress is not to exceed 30 N/mm^2 and (ii) the circumferential stress is not to exceed 45 N/mm^2. (6)

Module 3

15 A 12 m long beam simply supported at the ends carries a point load of 40 kN at 3 m from the left end and a uniformly distributed load of 10 kN/m on the right half of the span. Draw the shear force and bending moment diagrams indicating principal values. (14)

16 Draw the shear force and bending moment diagrams for the beam shown in figure, indicating principal values. (14)



Module 4

17 The tension flange of a cast iron I – section beam is 240 mm wide and 50 mm deep, the compression flange is 100 mm and 20 mm deep whereas the web is 300 mm x 30 mm. Find the load per m run which can be carried over a 4 m span by a simply supported beam if the maximum permissible stresses are 90 MPa and 24 MPa in tension (14)

18a A beam simply supported over a span of 5m, is loaded with a central point load of 80 kN. The section of the beam is rectangle, 200 mm wide and 400 mm deep. Calculate the maximum shearing stresses at points 200, 150 and 75 and 0 from the neutral axis of the section. (8)

b A timber beam 100 mm wide and 150 mm deep supports a uniformly distributed load of intensity w kN/m length over a span of 2 m. If the safe stresses are 28 N/mm^2 in bending and 2 N/mm^2 in shear, calculate the safe intensity of the load which can be supported by the beam. (6)

Module 5

19 The normal stresses at a point in an elastic material are 100 MPa and 60 MPa respectively at right angle to each other with a shearing stress of 50 MPa. Determine the principal stresses and the position of principal planes if (i) both the normal stresses are tensile (ii) 100 MPa stress is tensile and 60 MPa stress is (14)

compressive. Also determine the maximum shear stress and its plane in both the cases.

20a A 4 m long hollow alloy tube with inside and outside diameters as 36 mm and 48 mm respectively elongates by 3 mm under a tensile force of 50 kN. Determine the buckling load for the tube when it is used as a column with both ends pinned and the safe load with a factor of safety of 5. (8)

b A 1.5 m long solid aluminium shaft with a 60 mm diameter is to be replaced by a steel hollow shaft of the same length and same external diameter to transmit same torque with same angle of twist over the same length. Determine the internal diameter of the hollow shaft. Modulus of rigidity for steel = 82 GPa and that for aluminium = 27 GPa. (6)